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Understanding intersecting gender inequities in academic scientific research career progression in sub-Saharan Africa

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ABSTRACT
The slow progression and under-representation of women in senior scientific career positions is a well-known and persistent global problem, especially among university-based academics, particularly in sub-Saharan Africa (SSA). To inform action for change, we need to go beyond numerical evidence of inequalities to understanding the underlying social, cultural and institutional drivers and processes producing gender inequities in science careers. This requires a theoretically rigorous gender analysis framework that is relevant to SSA and sufficiently accounts for variations among both women and men. Since no such framework is available, we conducted a literature review of emerging theories and empirical evidence on the dimensions of and reasons for the prevailing gender inequities in higher education institutions in SSA. Based on this, we propose an integrated conceptual framework, identify available empirical findings to support it and develop a preliminary explanation of observed inequities. Our findings demonstrate that women's (lack of) progression in academic/scientific research careers is shaped by intersections between gender roles and social power relations of gender within the family, wider society and academic institutions themselves. We argue that this integrated model provides implications for theory, practice at institutional and policy level, and future research.

KEYWORDS
Gender inequity; academic scientific career progression; higher education institutions; sub-Saharan Africa; gender analysis framework; intersectionality

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INTRODUCTION

The slow progression and under-representation of women in senior positions in scientific careers is a well-known and persistent global problem, especially among university-based academics (Mavriplis et al., 2010; The Royal Society, 2011). The "leaky pipeline" metaphor has often been used to describe the slow advancement and increasing under-representation of women at each stage of the scientific career ladder (Miller and Wai, 2015; Thege et al., 2014). Specifically, in science, 2013 data show that while globally, women are slightly over-represented at Bachelors and Master's degree level (accounting for 53 percent of total enrolments), their share drops to 43 percent at PhD level and falls further post-doctorally, to 28 percent of scientific research staff (UNESCO, 2015). Accordingly, the combination of factors that slows down and reduces the proportion of women at each stage of a scientific career include: the graduate-level environment; the maternal wall/glass ceiling; performance evaluation criteria; lack of recognition; lack of support for leadership bids; and unconscious gender bias (UNESCO, 2015).

Sub-Saharan Africa (SSA) is particularly lacking in such gendered data, although the region has been identified as having the lowest numbers of women in science careers (Beintema, 2017). This is hampered by incomplete statistics for Africa's tertiary institutions, which do not reflect the likely complexity, with potential for great variation between countries and higher education institutions (HEIs) (Mama, 2006). Nonetheless, women are still predominantly located in relatively marginal and junior positions (Mama, 2006). Although more detailed quantification of the nature and degree of gender inequalities in higher education, including science, are required, this will not in itself explain such differences or suggest remedial strategies (Mabokela and Mlambo, 2015; Morley, 2005). Studies on gender and institutional culture in the context of the African university and their convergence in the post-colonial historical period have, largely, been neither described nor theorised, nor mapped to evidence in an integrated way (Mama and Barnes, 2007). To inform action for change, there is a need to understand and document the underlying social, cultural and institutional drivers and processes that produce gender inequities in science careers in HEIs in Africa, which has not been done in a holistic manner to date (Beoku-Betts, 2005; FAWE, 2015; Mama, 2006; Mama and Barnes, 2007; Morley, 2005; Thege et al., 2014). Furthermore, African scholars, such as Mama (2006) have emphasized the need for studies on gender equity in African Universities anchored by a theoretically rigorous gender analysis framework/theory, and grounded in a thorough and respectful understanding of African realities. Unfortunately, no such framework is currently available as most studies that focus on the qualitative experiences of women once they gain entry into academic careers in SSA remain largely untheorized (Morley, 2005).

Commentators have also highlighted the binary notion of gender that tends to be the central construct and category of analysis in most of the literature on science careers in higher education in the developing world (Morley, 2005), with relatively little attention devoted to variation among women and men (Jacobs, 1996). Failure

to address diversity in studies of gender and science by ignoring other intersecting and historically situated hierarchies of oppression such as race, culture, ethnicity, and class among others, tends to silence those women [and men] scientists who might raise different questions about science (Beoku-Betts, 2005). There is little knowledge from Africa, about how gender intersects with multiple intersectional axes of disadvantage, such as disability, ethnicity, religious, linguistic, or regional minorities, to produce inequities in career progression for both female and male research scientists.

This paper aims to contribute towards efforts to develop a theoretically informed and holistic analysis of the issue by positing an integrated conceptual framework for explaining gender inequities in scientific career advancement for women and men, and their intersections with multiple social axes of disadvantage in SSA. To achieve this goal, this paper draws on recent empirical literature reviews on gender inequities in academic and scientific career progression in higher education institutions in the African context, as part of a wider ongoing programme on 'Developing Excellence in Leadership, Training and Science (DELTAS) Africa Learning Research Programme'.[1] The paper is organized as follows: Section 2 lays out the methods used for the literature search; Section 3 presents an analysis of existing frameworks, concepts and theories based on the global literature; Section 4 presents our proposed integrated conceptual framework and describes its components based on available empirical evidence from SSA literature. Section 5 highlights the implications and study limitations, while Section 6 draws conclusions for policy, practice and future research.

METHOD

We conducted a systematic search and narrative review of literature from Africa. Such an approach involves a comprehensive search process to produce 'best evidence synthesis' of what is known and recommendations for practice through narrative synthesis (Grant and Booth, 2009). Our strategy involved systematized searching for published peer reviewed articles through exploring multiple bibliographic electronic databases, including: Project MUSE, EBSCO Discovery Service, Scopus, Web of Science, Education Research Complete, ERIC and Science Direct. Google scholar was also used to identify additional studies, including those present within the grey literature. Search terms and their variations were tested for their appropriateness with expert advice and assistance from the LSTM librarian.

Table 1: Search terms that were used in the identification of literature materials

Bodies of literature /theme	Search terms
Gender, Disability, Ethnicity and Language	gender inequality OR gender inequity OR gender equality OR gender equity OR gender OR women OR men OR under-represented OR Disability OR disabled OR impairment OR Minorities OR Ethnicity OR Language OR Discrimination OR intersectionality
Career pathways and Institutions	Career pathways OR scientific career pathways OR trajectories OR scientific career progression OR career advancement OR education OR institutions OR higher education OR research institutions OR educational institutions OR Tertiary education OR opportunities OR experiences OR enablers OR barriers
Geographical context (Africa)	Africa OR sub-Saharan Africa OR LMIC OR low resource OR low-income country OR developing country OR low to middle income

The search encompassed English, French and Portuguese language studies published anytime up to 2019 by combining the search terms under the three themes. The search identified 6,954 papers, all in English. Abstracts of published papers were reviewed for relevance to the study topic; relevant papers were retrieved for review and narrative synthesis based on emergent themes. Additional articles and reports were obtained through targeted internet searching of key institutional websites such as United Nations Educational, Scientific and Cultural Organisation (UNESCO), Association of African Universities (AAU) and African Women in Agricultural Research and Development (AWARD). In total, 35 relevant papers, including 25 peer-reviewed articles, 5 reports, 3 theses and 2 book-chapters were included in the present review of empirical evidence from the existing African literature. These were published between 2003 and 2019 and mainly focused on women in academic careers. (See Appendix 1)

AN ANALYSIS OF EXISTING EMPIRICAL EVIDENCE, FRAMEWORKS, CONCEPTS AND THEORIES BASED ON GLOBAL LITERATURE

The last few decades have witnessed unprecedented interest in women's under-representation and attrition in science careers globally. The 'problem' has largely been framed in terms of women's numerical representation at different levels and the barriers to their career progression (Vilnius, 2007). Such barriers are often conceptualized as arising at individual, socio-cultural and institutional levels, which interlock to cause 'leaks'/attrition or 'getting stuck' at various segments in the science pipeline (Miller and Wai, 2015). Some studies also focus on identifying existing 'enablers' to progress. In SSA, there is a paucity of empirical studies with comparable data on gender and higher education (FAWE, 2015; Raburu, 2015). Of those scholars who have investigated the problem of persistent gender inequities in scientific career progression within SSA, only about a third explicitly articulate their theoretical and conceptual approaches. The majority of these included theories that might loosely be considered intersectional. For example, theories used to explore the experiences of women as doctoral students, academics and administrators have

included Critical Race Feminism theory (Snyder, 2014), Black feminist theory (Mabokela and Mlambo, 2015), intersectionality (Johnson, 2014), 'gendered organizational cultures' (Mabokela and Mawila, 2004), and 'Getting On' and 'patriarchal closure' (Beoku-Betts, 2005). Notably none of these studies included a comparative consideration of men's experiences. In addition, the social model of disability has been used to examine the experiences of female and male university students with physical disabilities in their struggles around entry and career progression in academia in Africa (Matonya, 2016; Moswela and Mukhopadhyay, 2011). These studies focused mainly on the influence of disability but did consider intersection with gender to some extent.

All these varied theoretical and conceptual lenses remain useful in illuminating some of the experiences and challenges facing women at different levels. However, used on their own, they fail to sufficiently account for numerous and complex individual, socio-cultural and institutional drivers and processes that produce intersecting gender inequities in career progression for women and men. There is a growing recognition that a holistic approach is required, which identifies the complex interaction between contributing factors and processes in order to create sustained change both individually and collectively (Wilson et al., 2017). Our review did not identify a single framework or model that went beyond a list of 'challenges' to a deeper, holistic analysis of the complex structural constraints and processes that produce intersecting inequities in scientific career progression of women and men in HEIs in SSA. To consolidate and integrate the existing empirical evidence from a conceptual point of view, we considered relevant explanatory theoretical models or frameworks from the available global literature in relation to science careers. There are multiple career development theories and models. These include, among others, the Social learning theory of career decision making (Krumboltz, 1979); Social cognitive career theory (Cinamon et al., 2016); Role identity theory (Wilson et al., 2017); and the Social capital theory of career success (Seibert et al., 2001; Obers, 2015). However, most elucidate a single explanatory framework, rather than providing a comprehensive and holistic approach that encompasses the range of factors contributing to inequities in career progression. Therefore, we focused on those frameworks that might support us to answer our research question – that is those that holistically identify factors at individual, socio-cultural and institutional levels that shape career progression of women and men academic scientific researchers from junior to senior levels. We selected three theories and models: Systems of Career Influences Model (Magrane et al., 2012); the Social Relations Approach (Kabeer, 1994; Kabeer and Subrahmanian, 1996; March et al., 1999); and Intersectionality theory (Crenshaw, 1991; Hancock, 2007) which we describe and analyse below.

The systems of career influences model

This model was developed by Magrane and colleagues in response to a 2007/2008 call by the United States National Institutes of Health Working Group on Women in Biomedical Careers for research to address the persistent gap in the evidence for approaches to advancing women in biomedical science, despite a steady increase in enactment of policies that aim to level the playing field in medical school and doctoral science programmes (Magrane et al., 2012).The model serves as a tool for exploring factors influencing women's progression to advanced academic rank,

executive positions, and informal leadership roles in academic medicine. It is based on a summary of empirical literature on women's career development, best practices in professional development programs, and the collective experiences in academic leadership development in the USA context. The model situates faculty as agents within a complex adaptive system consisting of a trajectory of career advancement from early career, through mid-career to senior levels; a dynamic system of influences of organizational policies, practices, and culture; and a dynamic system of individual choices and decisions. Within these systems, women weigh competing influences to make choices and decisions, which may either promote or inhibit their career advancement. We selected this model because it was the only one that we identified that provides a structured approach for exploring the range of influences on women's career advancement along the scientific pathway, across organizational, individual, and societal dimensions. However, this model takes an individualistic focus on women's choices towards career progression rather than accounting for the gendered structural influences on those 'choices'. As such it reflects broadly neo-liberal and liberal feminist theoretical stances, which risk obscuring the specificities of the multiple oppressions faced by women of colour and women of the global south at the intersections of patriarchy and (post)colonial power relations. Tikly (2011) reminds us of the importance of pursuing a post-colonial analysis when researching on education systems in Africa, which could have implications for disadvantaged groups who encounter differential barriers in accessing quality education. We therefore decided to utilise a framework developed specifically in the global South to deepen our analysis of structural context.

Social relations approach

Gender inequity in higher education is a feature of social relations, as it shapes the production and reproduction of gender privileges and disadvantages which are inextricably linked to career progression of women [and men] (Morley, 2005). However, there has been little sustained attention globally to the role that higher education plays in challenging and reproducing gender privileges and disadvantages based on existing social relations (Morley, 2005). There are numerous commonly used gender analysis frameworks such as the Harvard Analytical Framework (also referred to as a the Gender Roles Framework or the Gender Analysis Framework), Longwe's women's empowerment framework, Moser's gender needs assessment framework, and capacities and vulnerabilities analysis framework (March et al., 1999). A commonly used gender analysis framework focusing on social relations in institutions is the Social Relations Approach (SRA), developed by a Southern feminist - Naila Kabeer - in collaboration with policy makers, academics and activists primarily from the global South (Kabeer, 1994). The SRA draws on post-colonial socialist feminist thinking as a theory for feminist change, which challenges and contests the fixity of gender, race, and culture, and directs attention to intersectional factors as socially produced through historical, socio-economic and political processes of colonialism (Kabeer, 1994). It therefore offers an institutional analysis of how gender inequities are produced as a constituent part of 'social relations', which describe the structural relationships within institutions that create and reproduce systemic differences in the positioning of different groups of people including those of class, race, ethnicity, and so on (Kabeer, 1994; Kabeer and Subrahmanian, 1996; March et al., 1999). The core premise of SRA is that gender analysis should go beyond analysing roles and responsibilities for men and women

to include how gender inequities are created and perpetuated through the patterns of social interactions in different contexts. Kabeer (1994) reminds us that for SRA to be useful, it is important that the institutional analysis of gender relations is linked with the general macro-economic policy/context which are informed by a broader set of social relations through which production is organised and human needs are met (pg. 285).

The four key institutions identified in the SRA are the: state, market, community and family; with the family taken as a logical starting point for such an analysis because of its central role in enabling, constraining and differentiating its members' participation in the economy and society at large. Kabeer argues that social relations in all these institutions are defined by five distinct, but inter-related, dimensions of social relationships which are key to gender analysis and which include: (i) '*rules',* which may be formal or informal, with the latter expressed through norms, values, laws, traditions, and customs that determine how things are done through allowing or constraining: what is done; how it is done; by whom it will be done; and who will benefit. (ii) '*resources'* include financial, social capital, or physical resources, the mobilisation and distribution of which often corresponds to an institution's rules (iii) '*people'* refers to the inclusion or exclusion of individuals in social processes, assignment of resources, tasks, and responsibilities and positioning in hierarchies (iv) '*activities'* refers to differing roles performed by individuals, based on routinized pattern of allocation and practice for carrying out tasks, through which certain tasks get attached to certain social groups (v) '*power*' determines who decides and in whose interest decisions are taken in institutional relations of authority and control. Kabeer (1994) posits that power in the analysis of SRA is inherent in the social relations which enable men to mobilize a greater range of resources - symbols and meanings, authority and recognition, objects and services- in a greater range of institutional domains, including political, economic and familial, which are shaped by intersections of patriarchy, capitalism and racism (pg.66).

The SRA thus provides deeper insight into the specificities of how structural gender relations and other social inequalities operate within institutional contexts, which we found to offer a good 'fit' in explaining the varied dimensions of gender disadvantage emerging from the empirical literature. However, since the theory is general and does not identify specificities of social relations within academic institutions, we argue that it may be productive to integrate it with Magrane's framework. In addition, whilst the SRA advocates for the need to go beyond gender in understanding the structural relationships that create and reproduce systemic differences for different groups of people characterized by class, race, and ethnicity, it is evident that most studies on career advancement of women treat them as homogenous group (Magrane et al., 2012). It may therefore be important to draw specific attention to the importance of heterogeneity among women and men, by drawing on the insights generated by the application of intersectionality theory, which specifically considers how the intersection of multiple axes and drivers of inequity constitutes unique and shifting positions for individuals within a complex web of power relations.

Intersectionality theory

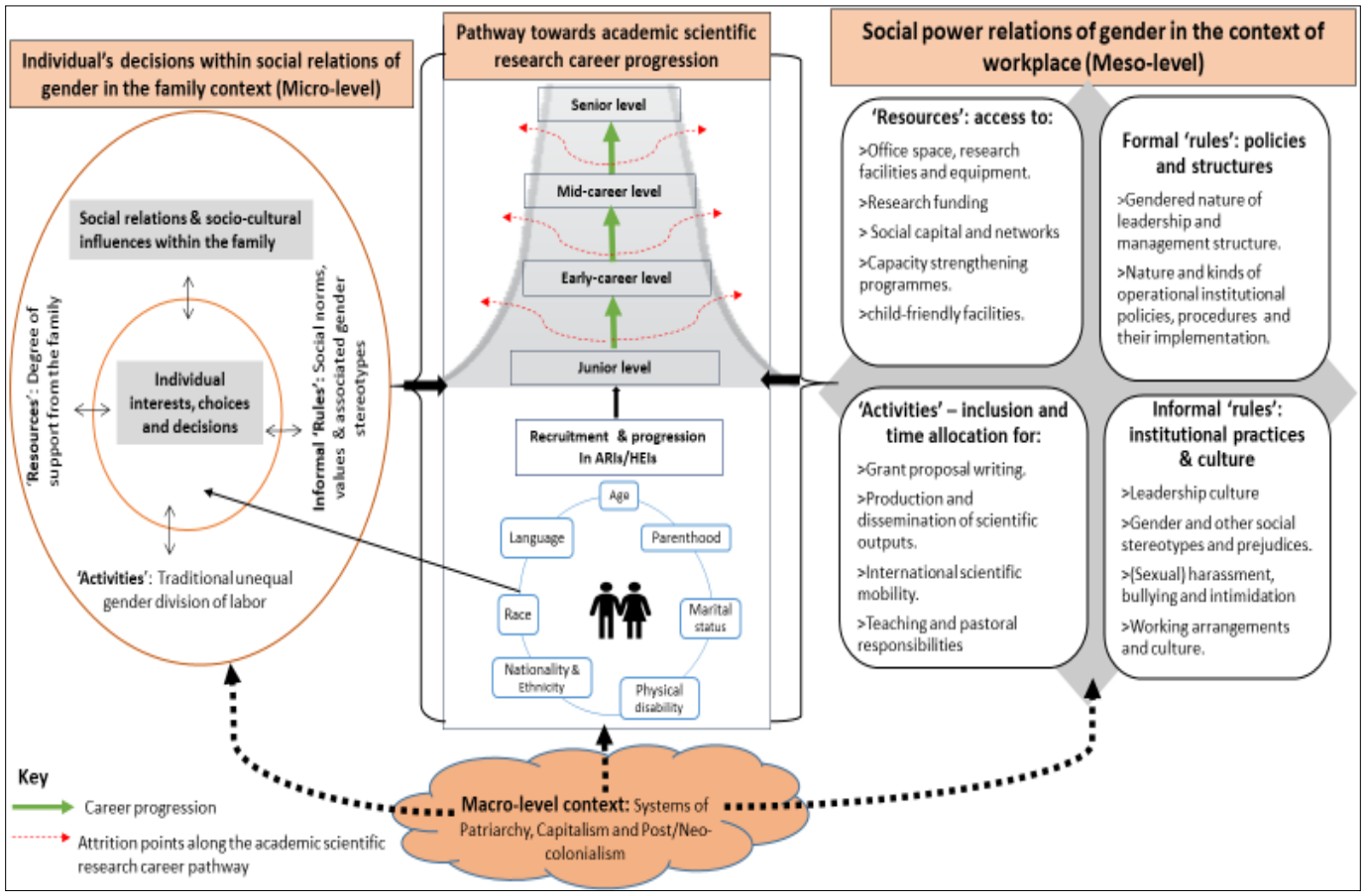
The concept of intersectionality originates among Black feminists in the United States, with the term being coined by Crenshaw (1991) to denote how connected and interdependent systems of race, class, gender, ethnicity, and other markers of difference (such as sexuality, religion, age and (dis)ability, marital status) intersect and interact with institutions and structures in society to privilege certain groups over others, and to maintain power. The intersections of gender with other dimensions of social identity (at the micro level of the household and community, as well as the individual or 'self') are therefore the starting point of this social theory (Crenshaw, 1991). These intersections occur within a context of connected systems and structures of power in institutions at the meso level (e.g. state laws, policies, bureaucracies, religious institutions, media). Through such processes, interdependent forms of privilege and oppression shaped by macro-level historical forces such as colonialism, imperialism, racism, homophobia, ableism and patriarchy are created (Hankivsky, 2014). Using an intersectionality lens therefore entails a multi-level analysis to understand the effects between and across micro, meso and macro levels in society. Attending to this multi-level dimension of intersectionality also requires addressing processes of inequity and differentiation across levels of structure, identity and representation, while acknowledging that social inequalities are context specific, and which reveal themselves through the process of intersectional research and discovery (Hankivsky, 2014). In an institutional context, intersectionality theory is concerned with how institutionalized systems of oppression interconnect to create specific manifestations of discrimination, and disadvantages, sometimes simultaneously with privilege and advantages, for particular individuals or groups of people based on their socio-demographic characteristics, known as their social 'location'. There is some debate about the degree to which an intersectional approach adds to social relations analyses of gender (which are arguably already informed by these insights) and the legitimacy of specifying gender as a focus within intersectional analyses (Hancock, 2007). In our view, the lack of consideration of intersecting inequalities in many accounts of women's disadvantage in academic institutions merits an explicit consideration of intersectionality in a comprehensive framework, which is complementary to a social relations approach when researching scientific career progression (Dubois-Shaik and Fusulier, 2015; Hancock, 2007). However, current lack of clarity about operationalizing intersectionality at an analytical level suggests the utility of retaining social relations theory as a clear framework for analysis.

THE PROVISIONAL INTEGRATED CONCEPTUAL FRAMEWORK

Based on insights from the three models, we developed an integrated conceptual framework (Fig. 1) that builds upon the 'systems of career influences' model of career progression (Magrane et al., 2012), combining this with a social relations gender analysis framework to explain how institutional social relations and processes produce and perpetuate gender inequities (Kabeer 1994; March et al., 1999) and an intersectional perspective that focuses on how gender intersects with other social relations of power (Crenshaw, 1991; Hancock, 2007). We propose this framework as an integrated approach to conceptualising how gendered social relations and processes in the institution of the family intersect with those in academic institutions to shape opportunities to progress along the academic

scientific research career pathway within African research institutions. This is in ways that are shaped by their multiple social identities within wider social relations.

Figure 1: An integrated conceptual framework for understanding intersecting gender inequities in academic scientific research career progression in HEIs in SSA



The model by Magrane et al. (2012) provides the central core of the framework, which focuses on the interplay between individual and organizational factors at different career stages. Kabeer's (1994) framework identifies key dimensions for an institutional gender analysis, expressed as 'rules' (formal and informal), 'resources' and 'activities', which are all permeated by 'power'. 'People' are located as individuals at the centre of the family and as entrants into the career pathway. The intersectionality lens is then explicitly added to highlight the multiple social identities and related power of these individuals according to aspects such as age, professional cadre, marital status, ethnicity, language minority, (dis)ability, and parenthood. We applied this framework to the available empirical findings from Africa by mapping the existing evidence onto it and developed a preliminary explanation of observed inequities. In the next section we describe this integrated framework through unpacking its various components based on our synthesis of available scholarly evidence on gender inequities in academic scientific career progression in HEIs in SSA.

Pathway towards academic scientific career progression for researchers in Africa (middle box)

The academic scientific career pathway typically progresses from undergraduate to post-graduate level (junior level), through 'early career' or post-doctoral positions, to mid-level academic scientific research positions and finally to senior level, culminating in professorships (The Royal Society, 2011), although the process may not be linear, especially in SSA. We take gender as a key entry point into analysing the positionality of individuals shaping this pathway, who according to intersectionality perspective, may further be identified as (dis)advantaged based on other multiple intersecting social categories. Disadvantage may shape barriers to entry and progression, as well as retention in academic scientific careers: some may 'leak' out of the pathway by leaving academia or science altogether.

As represented by the pyramid, women are typically increasingly under-represented and slowly progressing along the pathway to senior positions (Teferra and Altbach, 2004). Females account for a consistently lower proportion of the graduate student population in science [technology, engineering and mathematics] than males across African HEIs although there is little evidence of higher drop-out among female students (FAWE, 2015; Masanja, 2010). As a result, fewer women enter academic positions, particularly beyond junior levels (Mabokela and Mlambo, 2015) and ultimately comprise less than 10 percent of professioral level faculty in most African countries (Mama and Barnes, 2007). Notably, unlike industrialized countries where significant research takes place in specialized types of institutions, in Africa most of research is conducted in universities, which are thus the main sites of where research knowledge is dispensed, acquired, and produced (Assié-Lumumba, 2006). Much of the available literature on scientific career progression in Africa therefore focuses on higher education institutions. The following sections explore how the social relations of gender in the family and academic and scientific institutions intersect with each other and with other social power relations to influence women's entry, retention and progression in their careers.

Individual's decisions within social relations of gender in the family context: Micro-level (left box)

This denotes the '*micro-level context'* in which social relations of gender are produced, shaped and propagated to other levels. There is considerable evidence from African studies that the persistent allocation of the brunt of reproductive labour to women slows down their career progression (i.e. Beoku-Betts, 2004, 2005; Callaghan, 2016; Jansen Van Rensburg, 2007; Lumby and Azaola, 2014; Mabokela and Mlambo, 2015; Prozesky, 2006, 2008; Thege et al., 2014). In most African contexts, women are socially identified as wives, mothers and carers, and spend on average significantly more time caring for children and the elderly than men (Beoku-Betts, 2004). Women's disadvantage with regard to time availability for their careers is particularly related to marriage and child-bearing, which for the majority occurs whilst they are still in post-graduate education (Beoku-Betts, 2004; Nyamongo, 2007). However, the extended nature of most African families means that women tend to have domestic responsibilities regardless of their marital status; for example responsibility for raising the children of less privileged family members, which may be particularly acute in the context of conflict and economic

crises (Beoku-Betts, 2005). Professional women are therefore constrained in competing with their male counterparts in terms of allocating time to activities that contribute to career progression such as grant and scientific writing and publication (Beoku-Betts, 2005).

Reproductive responsibilities reduce many women's opportunities to take up opportunities to study or work internationally, which can be an important source of academic capital and networks that support progression. For example, a study in Rwanda reports that many women 'stuck' at junior levels turn down scholarships for studying abroad due to concerns about the impact on their marriage or having young children whom they are unable to leave behind because of lack of support at home (Masanja, 2010). Conversely, the social expectation to 'follow' a spouse as they develop their career can lead to postponement, 'fractures' or changes in direction in women's careers (Mabokela and Mlambo, 2015; Prozesky, 2008).

In contrast, many women cite supportive family relationships from their spouses, mothers, siblings, including members of the extended family, as integral to their professional success strategy through childcare and moral support (Mabokela and Mlambo, 2015). For women without such support, career progression may come at high personal cost. For instance, one female academic in a study at the University of Ghana reported that she made a difficult and painful decision to leave her 15 month- old baby to pursue a doctoral degree overseas, in order to keep her position at the University, which contravened societal norms (Mabokela and Mlambo, 2015). For some women, the social costs of career progression may include divorce or separation (Beoku-Betts, 2004), or strategic decisions to challenge socio-cultural norms and expectations by not getting married (Mabokela and Mlambo, 2015).

Unequal allocation of reproductive responsibilities thus account for a cumulative disadvantage to women in representation and progression in science careers in ways that may be alleviated or exacerbated by life stage, family support and social context (Masanja, 2010). There is a lack of information from existing studies about how 'informal rules' of gender in the family and society beyond girls' and women's reproductive roles, such as gender stereotypes and constraints in subject choice, may influence women's career progression (Assié-Lumumba, 2006).

Social power relations of gender in the context of workplace: Meso-level (the right box)

There is evidence from the empirical literature of how *gender power relations within academic institutions* further intersect with gender power relations within the family and wider society to create disadvantage for women, in ways that may be exacerbated or mediated by other social power relations. Institutional power relations are manifested in operational policies and power structures (*formal rules*); institutional practices and culture (*informal rules*); access to the necessary research infrastructure or *resources*; as well as inclusion in and expectations of research *activities.*

Formal 'rules': policies and structures. Studies from SSA have characterised universities as persistently male-dominated spaces (Mama and Barnes, 2007; Teferra and Altbach, 2004), particularly in terms of representation, decision making procedures and leadership, with gender-blind and discriminatory policies (FAWE, 2015; Onsongo, 2006, 2007). Power structures are generally rigid (Johnson, 2014),

whilst decision-making cultures are often conservative and inflexible (Onsongo, 2006), offering few opportunities for influence beyond the male dominated leadership positions.

The paucity of women involved in the leadership levels of HEIs compounds the lack of gender-responsive policies. Where there are policies in place, their translation into practice is not adequately or effectively done or monitored, resulting in the maintenance of the status quo (FAWE, 2015). Without bodies or persons designated to ensuring that these policies are acted upon, they often remain reference documents that are used to show that efforts have been made to address gender inequality rather than demonstrating commitment to action (FAWE, 2015). 'Gender blindness' is manifested through lack of policies and effective sanctions against sexual harassment, sexual violence and bullying (FAWE, 2015).

Informal 'rules': institutional practices and culture. Gendered power relations are enacted and reinforced through everyday institutional practices and culture within the work environment. Studies have shown that even though academic institutional cultures in many African contexts are visibly opening to women's participation, they continue to perpetuate working cultures that are not favourable to women's social and cultural experiences (Mabokela and Mlambo, 2015). Broader societal norms and values in Africa influence professional relationships, experiences and organizational practices, which are still male-dominated, and tend to marginalize "women's ways of knowing and doing" (Mabokela and Mawila, 2004) as well as reflecting gender stereotypes and practices. For instance, women in a South African university argued that beliefs and attitudes portraying women as inferior and incompetent were rooted in patriarchal culture, and were extended to institutions of higher learning, such as in a proverb stating that "if you give an institution to a woman, it will collapse", with men believing that they had the "divine right" to occupy all leadership positions (Mabokela and Mawila, 2004: 406). The gender relations of family are also carried over into the workplace, with female academics reporting male colleagues taking a negative attitude towards women who prioritize their careers over marriage and family obligations (Beoku-Betts, 2005) and undermining their status and expertise by expecting them to "serve them like their wives would at home" (Mabokela, 2003: 142). Reflecting on their early career experiences in a public university in Ghana, participants experienced some form of belittling or discrediting as women, including a female assistant professor being addressed as 'Mrs' whilst male colleagues were addressed as 'doctor' (Beoku-Betts, 2005). African Universities are thus spaces and places intricately marked with codes for man-as-thinker, man-as-aggressive-debater, man-as-athlete, boys-becoming-men (Mama and Barnes, 2007).

Gender stereotypes may also intersect with other social stereotypes such as those related to age and race. For example, another study in Ghana documented that women academics perceived their young age or youthful appearance as a barrier in gaining respect as a professional among their colleagues and students (Mabokela and Mlambo, 2015) regardless of scholarly accomplishments, which has the potential to negatively impact career progression of young women. By drawing attention to the experiences of the South African Black women scholars through a qualitative study, Mabokela and Mawila (2004) report that participants reflected on how their race negatively impacted on their professional experiences as female

academic staff. Specifically, they complained that their Indian and White male colleagues often negatively criticized their professional contributions, were overtly hostile and enacted subtle discriminatory practices. They often treated them as if they were "nothing" and colluded against them to keep their position of privilege (Mabokela and Mawila, 2004).

Such gendered relations play out in formal processes such as promotions panels. In Kenyan universities for example, interview panels for promotion are usually male-dominated, and female candidates for managerial or professorial positions are often subjected to irrelevant, gender-biased questions (Onsongo, 2006). Still in Kenya, several studies have identified the importance of male power and patronage networks in promotion decisions (Raburu, 2015), in addition to other non-merit factors that also affect men, such as tribalism, nepotism and political loyalties (Onsongo, 2006).

Educational organizations in SSA are often unfriendly environments for women due to a spectrum of behaviours from bullying and discrimination to sexual harassment and gender-based violence (Assié-Lumumba, 2006; Johnson, 2014; Mama and Barnes, 2007), creating constraints to their progression (Onsongo, 2007). Women experience 'everyday' hostility and bullying in the form of male intrusion in their areas of responsibility, interruption of meetings run by women managers, and political interference (Onsongo, 2007). Practices such as scheduling important decision-making meetings outside of core working hours indirectly discriminates against many women by effectively excluding those with reproductive responsibilities (FAWE, 2015; Onsongo, 2006).

Availability and access to research-oriented 'resources. There is some empirical evidence from SSA showing perceived gender inequities in allocation and distribution of tangible institutional research '*resources*', especially for junior level faculty, such as computers in the case of Ghana and Kenya (Campion and Shrum, 2004) and laboratory supplies and equipment in sub-Saharan Africa in general (Beoku-Betts, 2005). In South Africa, findings from a qualitative study conducted amongst Gauteng-based female early career academics in the Science, Engineering and Technology fields found that women between 30 and 35 years are often penalized in research funding allocation (Mawela, 2014). Participants felt that reviewers, most of whom are men, view this life-stage as dominated by childcare responsibilities and thus allocate resources to male counterparts who are seen as having more time to dedicate to research (Mawela, 2014).

The social and professional capital and networks, including peer groups/collegial networks, mentors and role models, are highly influential on scientific career progression. Empirical evidence suggests that compared to men, women tend to have weaker social capital and networks, particularly as a result of limited mobility for conference attendance due to reproductive responsibilities (Obers, 2015). In addition to the constraints on taking up networking opportunities, 'old boy' networks tend to exclude women when discussing career progression matters such as promotions and scholarships informally over lunch or evening drinks, as reported by a study in Kenya (Raburu, 2015).

In SSA, Beoku-Betts (2004) found that African women as graduate students in the sciences perceived peer groups as influential on academic achievement, but the

majority reported a lack of positive peer group experiences or collegial support from fellow (female and male) graduate students (Beoku-Betts, 2004). Moreover, with fewer women in senior positions, junior academic male staff are more likely than females to have role models and career mentors with experience of career progression (Mabokela and Mawila, 2004) and who are able and willing to promote their interests within institutions (Raburu, 2015). In a qualitative study of female academics in South Africa, Mabokela and Mawila (2004) found that none of their subjects had had mentoring or support on research and publication; instead, participants exclaimed that "*they simply put you in an office and you'd better figure out how you are going to survive"* (Mabokela and Mawila, 2004: 404). The same study attributed lack of mentorship to the limited recognition of this role in promotion considerations.

There is also evidence of inequities in allocation of career development/capacity strengthening opportunities in academic institutions (Morley, 2006). For instance, Beoku-Betts (2005) found that women in early career positions in SSA complained of exclusion from career development opportunities such as grants, scholarships, and fellowships. In addition, the built environment and services of many African universities has not been inclusive of women's needs as students and academic staff in terms of child care facilities (Mama, 2006; Raburu, 2015). In Ghana for instance, childcare was a concern for all women academics with young children, who perceived the absence of child support facilities within the university as evidence of the lack of institutional commitment to support women staff to achieve a reasonable work-life balance and to compete with their male colleagues on a level playing field (Mabokela and Mlambo, 2015).

Inclusion and time allocation for 'activities. In terms of '*activities*', neo-liberal labour relations in academic institutions, driven by macro-level forces of academic globalisation, increasingly focus on 'productivity measures' of scientific outputs such as peer-reviewed journal articles and grant income. These are often constructed as 'additional' to teaching loads, which implicitly assume time elasticity on the part of employees (Beoku-Betts, 2005; Callaghan, 2016; Obers, 2015; Prozesky, 2006). Progression in academic scientific careers also demands a very high level of international mobility (Ackers, 2004), because of the importance of visibility and engagement with global networks of scholars (Prozesky, 2006). Empirical evidence suggests that women scientists in Africa publish in peer reviewed international journals less than their male counterparts (Beoku-Betts, 2005; Prozesky, 2006), and also view writing grant proposals and applications to obtain institutional funding as a time consuming exercise that is often not fruitful, as highlighted in qualitative study conducted in Ghana (Mabokela and Mlambo, 2015). Due to their lack of time elasticity, many female scientists have opted for focusing on teaching responsibilities, which are seen as 'core' duties (Callaghan, 2016). This, together with gender stereotyping, contributes to a vicious cycle, whereby women tend to be allocated higher lecturing, administration, counselling and mentorship workloads compared to men (Raburu, 2015). Such duties are overlooked in the promotion process, which emphasizes almost exclusively research and publication outputs (Mabokela and Mawila, 2004; Onsongo, 2007). Men are therefore advantaged in the competitive process of applying for salary increases, promotion and professional recognition (Beoku-Betts, 2005).

Macro-level context: Systems of patriarchy, capitalism and post/neo-colonialism

We recognize that the social relations of gender at individual, societal and institutional level with differential implications to women and men who maybe disadvantaged by multiple social identities within HEIs in Africa, are in/directly reinforced by an overarching macro level context characterised by patriarchy, capitalism and post/neo-colonialism. Tikly (2011) emphasizes the need to understand the post-colonial context, which matters when investigating challenges and enabling environment within the African continent. We refer to this as the macro level context, in line with Kabeer's (1994) SRA which highlights the need for a macro-structural analysis of gender relations within the realms of capitalism, racism and patriarchy, which may be interdependent (pg.67). By echoing Kabeer's (1994) sentiments, Gordon (1996) accentuates the importance of theorising the relationship among structures of capitalism and patriarchy as intersecting macro-level social processes that provide the context for people's actions and beliefs, and how and why they change, and which are conditioned by historical and contemporary forces that produce differential inequities for women and men within each African society.

Available empirical evidence from SSA indicates that historically, women in Africa under colonial rule generally entered academia later than their male counterparts, as a systematic and deliberate colonial policy ensured that African women were excluded from the various "ivory towers" that dotted the continent (Adusah-Karikari, 2008). A variety of factors, including the emphasis on domestic chores, and the overarching influence of patriarchy, combined to make access to academic institutions for women an impossibility for much of the colonial period (Adusah-Karikari, 2008). Specifically, social structures put pressure on women to start a family ahead of professional considerations as the society expects women to bear the burden of caring for the young, elderly and the sick or disabled; a colonial legacy that left African women with a burden of having to pursue their academic interests while fulfilling their traditional or social responsibilities, a task which they bear with little or no help from the males (Adusah-Karikari, 2008).

Even though research on the experiences of Women in Higher Education in Africa in the past few decades indicates that women's access to education has generally increased, feminist researchers have suggested that patriarchy still dominates post-colonial life as much as it dominated colonial, everyday life, as women continue to remain in subordinate positions (Adusah-Karikari, 2008). Morley (2005) observed that many of the explanations for the gendered division of labour in the academy or women's lack of seniority stem from norm-related discourses of heterosexuality and patriarchy, which continue to create barriers for many women. More recently, Prozesky and Beaudry (2019) have accentuated that patriarchy still pervades the majority of African societies, and that its resulting gender-based divisions of labour both within the home and in the academic workplace have a negative impact on the careers of African women scientists.

Mama and Barnes (2007) have argued that the post-liberation state in Africa has been a disappointment for women, exacerbating inequalities in public higher

education. Specifically, the governments which took over after independence kept African state structures and systems as they were, and so tended to revert to traditional social and political systems and values which reproduced the repressive characteristics of the past (Mama and Barnes, 2007). In addition, for a long time in sub-Saharan African countries, there has been non-conducive environment for research as most national governments have not come to a recognition and appreciation that funds allocated for research are a good investment (Whitworth et al., 2008; Owusu et al., 2017). This has severely compromised the research environment, which is constrained by poor institutional facilities, heavy teaching loads, lack of mentorship programs for young faculty among other challenges that impact negatively on African research scholars (Owusu et al., 2017). As a result, the majority of research capacity strengthening initiatives in SSA aimed at bridging this gap are funded by global North, who tend to exacerbate historical inequalities and colonial exploitation and replication of persisting macro-economic inequalities characterised by draining of expertise, dependence on their funding, and power imbalances between researchers and institutions from the North and the South (Bowsher et al., 2019).

IMPLICATIONS

Our proposed integrated conceptual framework provides insights into understanding how the myriad of barriers faced by female academic scientific researchers to equitably progress along the career pathway is shaped by gendered social relations. A considerable number of authors have placed emphasis on unequal burdens of reproductive work, mainly family responsibilities, which remains a significant barrier that cuts across others, particularly to women's career progression in science in Africa. Our findings imply that although women's reproductive labour is seen as a critical stumbling block in their career progression, it is important to look at how this interrelates with other gendered drivers and to consider how gendered labour relations in the wider political economy lie at the root of this problem. Existing evidence from SSA points to the fact that women are equally under-represented in natural sciences and engineering in general, and particularly at high levels (Beaudry & Prozesky, 2017; Masanja, 2010; Okeke et al., 2017; Jesse, 2006). Therefore, this proposed framework which is based on review of empirical evidence on scientific and academic careers in SSA, may also be applicable to careers in disciplinary fields of technology, engineering and mathematics. However, this should be done with caution given that we did not specifically look for mathematics, engineering and technology disciplines in our literature search, which might be a limitation for application to such fields as whole.

Our review of the literature found few explorations of how intersecting social inequities may influence men's career progression, since most studies focused exclusively on women. This demonstrates the importance of having more male comparative studies. Such comparative studies can aid in establishing commonalities between the drivers of inequity for women and men who maybe disadvantaged by existing power relations, which may potentially form a basis for making strategic alliances and designing holistic interventions. Moreover, we did not come across empirical literature on learning from any successful interventions that have been used to address these issues. This clearly indicates that urgent attention should be paid to conducting research on HEIs in Africa, particularly from

a gender and social inclusion perspective, to provide up-to date evidence on which to develop targeted policies and programs to address the impediments to equitable scientific and academic career progression of female and male researchers.

Overall, the findings confirm that women in academic scientific research careers in Africa work under difficult circumstances characterized by issues of discrimination and segregation, gender-based violence and sexual harassment, time constraints, negative gender stereotypes and poor infrastructural services among others, and which can consequently impede their career progression. Moreover, academic and scientific institutions see combining family and career as a "private affair" for women; this could explain why there is minimal, or absence of, child care facilities in scientific institutions (Vilnius, 2007) and why career structures are generally considered to be 'gender neutral'. Analyses tend to be focused on the experiences of individual women, which though very important, can act to obscure the structural underpinnings of their experiences in the gendered political economy and to clearly distinguish the commonalities and differences from the experiences of male academics.

Study Limitations

We acknowledge that our empirical literature review is based on limited gender disaggregated published literature from SSA on this topic. Thus, many gaps in the evidence arise from the lack of comparative accounts of scientific career progression barriers for women and men as characterized by multiple social identities and as shaped by gendered social relations. Generally, the available evidence has focused on women, in studies whose titles denote gender. Similarly, the majority of the studies have treated women in academia and research careers as a homogenous group, without considering their differences and the complexities of how these may interact with gender relations. Moreover, we were unable to locate a study exploring barriers to equitable academic scientific career progression for women and men at each stage of the academic scientific career pathway.

We also recognise that the growing inequities in academic career progression of women and men in African HEIs differ by regions and countries which are characterised by unique history, culture, and political environments, in the way that they are positioned. However, Adisa and colleagues (2019) recently established that there seems to be a paucity of research about the challenges and impact of patriarchy on women's career progression in academia, specifically in the non-Western context, where patriarchy is highly prevalent. Our review led us to conclude that most studies tend to merely deduce, rather than directly investigate a link between patriarchy, capitalism and post/neo-colonialism, which is barely present in the empirical literature on career progression in HEIs in Africa.

CONCLUSIONS

Based on our review of existing empirical evidence from SSA, we have identified and analysed the individual, socio-cultural and institutional level barriers that negatively impact the ability of women in institutions of higher education to climb the academic scientific ladder resulting in their diminished representation in senior and institutional leadership positions. Our analysis of the empirical literature confirms the need for a new, integrated conceptual framework, since many of the

existing empirical studies lack explanatory power due to the lack of application of social theory, whilst most view women as a homogenous group. However, our ability to demonstrate the explanatory 'fit' of our proposed framework is itself constrained by the limitations stated above, as there is a lack of empirical studies with adequate comparative, intersectional, gender analyses, particularly to support a deep understanding of the effects of intersecting power relations.

We have made a case for our proposed framework in order to stimulate critical discussion on the problem of inequitable academic scientific career progression with a gender and social inclusion lens. Thus, it serves as a starting point towards understanding the problem and informing development of viable strategies and mechanisms for enhancing equitable career progression, that are grounded in, and based on available evidence from specific SSA contexts. This framework could be used by institutional research leaders and policy makers in considering areas in which they need to act through devising potential strategies to enhance equitable recruitment and career progression of academic and scientific researchers as well as improving their retention within specific institutions and in scientific careers in general.

Nonetheless, there is need for more comparative studies to ascertain the usefulness of the framework in explaining inequities in scientific career outcomes. For example, guided by this integrated conceptual framework, the first author (a PhD student) is currently conducting an empirical qualitative study that is aimed at examining the experiences of academic researchers at various career stages with regard to intersectional gender equity in their scientific career pathways, within the context of DELTAS Africa – a health-based scientific research capacity strengthening programme. The ultimate goal of this study is to produce evidence from a holistic, gender comparative and intersectional perspective of existing barriers and enablers that can be used to develop strategies to promote career equity for internationally competitive African scientific researchers while acknowledging their multiple social identities. Going forward, there is an urgent need for such studies to expand the focus beyond women as a single homogenous category, to develop comparisons with male scientists, to consider diversity in HEIs, and to move beyond individual experiences to identify the structural drivers of barriers and enablers in the wider gendered political economy.

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author(s) and not necessarily those of AAS, NEPAD Agency, Wellcome Trust or DFID

ENDNOTES

[1]The DELTAS Africa, a health based research capacity strengthening programme initiated by the Wellcome Trust, is a flagship programme of the Alliance for Accelerating Excellence in Science in Africa (AESA) at the African Academy of Sciences, aimed at developing science strategies and funding research in Africa. The DELTAS Africa 'Learning Research Programme' (LRP), embedded within the DELTAS Africa initiative, is led by the Capacity Research Unit of the Liverpool School of Tropical Medicine. One of its goals is to produce research-based learning about how to equitably develop internationally competitive and effective researchers and research institutions in SSA. Available at: https://www.lstmed.ac.uk/research/centres-and-units/centre-for-capacity-research/resources (site accessed on March 20, 2020).

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APPENDIX

Summary of documents reviewed from SSA (n=35)

Author	Type of publication	Context/ setting	Theory/ concepts	Method	Focus/data
Adusah-Karikari (2008)	Thesis	Ghana	Postcolonial feminism	Qualita-tive	Experiences of Women faculty and administrators in Higher Education in Ghana.
Assié-Lumumba (2006)	Report	SSA	N/A	Desk review	Gender and policy context of gender and higher education.
Beoku-Betts (2004)	Peer-reviewed article	SSA - Ghana, Nigeria, Sierra Leone, Camer-oon and Zimbabwe	N/A	Qualita-tive	Experiences of female women doctoral level scientists in research and academic institutions.
Beoku-Betts (2005)	Peer-reviewed article	SSA - Ghana, Sierra Leone, Nigeria, Cameroon Sudan, Zimbabwe and Uganda.	Concepts of 'Getting On' and 'patriarchal closure'	Qualita-tive	Experiences of women in academic scientific careers.
Callaghan (2016)	Peer- reviewed article	South Africa	N/A	Quantita-tive	Bivariate and multivariate analysis of relationships between the pressures faced by female and male academics to publish vis a vis family life.
Campion and Shrum (2004)	Peer-reviewed article	Ghana and Kenya	N/A	Quantita-tive	Comparison of female and male research careers in state research institutes, Universities, NGOs and international research centres.
FAWE (2015)	Report	SSA	N/A	Desk review	Gender inequality in HEIs.
Jansen Van Rensburg (2007)	Thesis	South Africa	N/A	Mixed method	Results from the survey and interviews with women at middle and senior management showed that challenges of work-life balance and lack of networking as highly ranked career advancement barriers.

Johnson (2014)	Peer-reviewed article	SSA – Zimbabwe Ghana, Nigeria, and Madagas-car	Intersection-ality	Qualita-tive	Life and career path experiences of female higher education administrators in SSA.
Lumby and Azaola (2014)	Peer-reviewed article	South Africa	Constructs of mothering, agency and emotional capital	Qualita-tive	Construction of motherhood by female academics and how these impacts on their leadership role in learning institutions.
Mabokela (2003)	Peer-reviewed article	South Africa	"Donkeys of the University" metaphor	Qualita-tive	Workplace experiences of Black women administrators in four HEIs.
Mabokela and Mawila (2004)	Peer-reviewed article	South Africa	Concepts of 'gendered organization al cultures of universities'	Qualita-tive	Experiences of professional advancement of Black female scholars and administrators in HEIs.
Mabokela and Mlambo (2015)	Peer-reviewed article	Ghana	Black feminist theorists (US)	Qualita-tive	Professional experiences of female academics at University in Ghana.
Mama (2006)	Peer-reviewed article	SSA	N/A	Desk review	Gender in and masculine institutional culture of African universities.
Mama and Barnes (2007)	Peer-reviewed article	SSA	N/A	Desk review	Gender inequalities in Africa's public universities.
Masanja (2010)	Report	SSA	N/A	Desk review	Women's participation in education and specifically STEM.
Matonya (2016)	Thesis	Tanzania	Social model of disability	Qualita-tive	Barriers to participation of women with disabilities in higher education.
Mawela (2014)	Book chapter	South Africa	Critical-interpretivist paradigm	Qualita-tive	Journeys of female Professors in SET fields in higher education.
Morley (2005)	Peer-reviewed article	SSA - Uganda, Nigeria, South Africa and Tanzania	N/A	Desk review	Gender and higher education in low-income Commonwealth countries.
Morley (2006)	Peer-reviewed article	Nigeria, South Africa, Tanzania, Uganda	N/A	Qualita-tive	Focuses on the subtle and complex ways in which discrimination against female academic staff and managers takes place in HEIs as evidenced through interviews.

Moswela and Mukhopadhyay (2011)	Peer-reviewed article	Botswana	Social model of disability	Qualitative	Experiences of male and female university students with disabilities in higher education.
Mukhebi et al. (2017)	Peer-reviewed article	SSA	N/A	Mixed method	Case study exploring the role of mentoring in increasing the pool of women in agricultural research (AWARD program)
Nyamongo (2007)	Peer-reviewed article	Kenya	N/A	Desk review	Socio-cultural factors influencing differential enrolment and completion for undergraduate and postgraduate anthropology students.
Obers (2015)	Peer-reviewed article	South Africa	N/A	Mixed method	Constraints and enablers of women academics' research careers within at Rhodes University.
Okeke et al. (2017)	Peer-reviewed article	SSA	N/A	Desk review	Women's underrepresentation in pursuing STEM disciplines.
Onsongo (2006)	Book chapter	Kenya	N/A	Mixed method	Inequities and discrimination in staff recruitment, training, promotion and work environment in public universities.
Onsongo (2007)	Peer-reviewed article	Kenya	Feminist perspective	Mixed method	Gendered relations in public universities and implications of the growth of private universities on gender equity in higher education.
Prozesky (2006)	Peer-reviewed article	South Africa	N/A	Secondary data analysis	Gender differences in journal publication productivity among academics 1990-2001.
Prozesky (2008)	Peer-reviewed article	South Africa	N/A	Qualitative	Early career and family experiences of women and men in relation to research productivity.
Prozesky and Beaudry (2019)	Peer-reviewed article	SSA	N/A	Quantitative	Multi-county survey (41 African countries) on geographic mobility of academic scientists in Africa, and how it relates to gender and career development.
Raburu (2015)	Peer-reviewed article	Kenya	Feminist perspective	Qualitative	Experiences of women academics from three universities.

Snyder (2014)	Peer-reviewed article	South Africa	Critical Race Feminism	Qualita-tive	Experiences of female doctoral students of colour in educational progress.
Teferra and Altbach (2004)	Peer-reviewed article	SSA	N/A	Desk review	Problems faced by female students and academic staff in African HEIs.
UNESCO (2007)	Report	Global	N/A	Desk review	Women and science in higher education.
UNESCO (2015)	Report	Global	N/A	Desk review	Statistical trends in women's representation in science research careers.